Document ID: EDF-ER-186
Revision ID: 0
Effective Date: 7/12/00

Engineering Design File

PROJECT FILE NO. OU 1-07B

In-Situ Bioremediation planning conceptual design and cost estimate

[The following statement is optional:
Prepared for:
U.S. Department of Energy
Idaho Operations Office
Idaho Falls, Idaho]

INEEL
Idaho National Engineering & Environmental Laboratory
BECHTEL BWXT IDAHO, LLC

Form 412.14
10/05/99
Rev. 02

ENGINEERING DESIGN FILE

Functional File No. ____________
EDF No. EDF-ER-186

1. Project File No. ____________ 2. Project Task OU-107B Field Demonstration Report

3. Subtask In-Situ Bioremediation (ISB)Treatment System Facility

4. Title: ISB planning conceptual design and cost estimate

5. Summary: This EDF establishes the In-Situ Bioremediation treatment system facility planning conceptual design and associated cost estimate. This design and cost estimate is used to evaluate alternatives to the In-Situ Bioremediation technology presented in DOE/ID-10718, *Field Demonstration Report, TAN Final Groundwater Remediation, OU1-07B*. The cost estimate is presented in Table 2-3 of the demonstration report. Conclusions and recommendations are presented in the demonstration report and are not presented in this EDF.

6. Distribution (complete package):

Distribution (summary package only):

7. Review (R) and Approval (A) Signatures: (Minimum reviews and approvals are listed. Additional reviews/approvals may be added as necessary.)

	R/A	Printed Name	Signature	Date
Author	R	Al Cram	Al Cram	7/12/00
Independent Verification	R	ER Operational Review Board Jerry Shea, Chairman	Jerry Shea	7/12/00
Requestor	A	Joe Rothermel, Project Mgr.	Joe Rothermel	7/13/00

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1. PURPOSE AND SCOPE

This EDF establishes the cost estimate and ISB Treatment System Facility conceptual design used as a basis in evaluation of alternatives (this conceptual design being one alternative) to the ISB technology presented in DOE/ID 10718, *Field Demonstration Report, Test Area North Final Groundwater Remediation, Operable Unit 1-07B*. The cost estimate is used in Table 2-3 of the demonstration report. Conclusions and recommendations are presented in the demonstration report and are not presented in this EDF.

2. COST ESTIMATE SUMMARY

The cost estimate is for versions 1 and 2 of the ISB Treatment System Facility conceptual design. The conceptual design addresses four versions, the difference between the versions being the assumptions about the TCE concentrations and mitigating factors at the in-situ source (see para 2.2 of the preliminary design for a description of the versions). The hardware and capital costs for versions 1 and 2 are the same.

Version 2 is the same as version 1 except the system would be operated indefinitely.

Version 3 uses the equipment for version 1 plus the existing Bioremediation Air Stripper Treatment Unit (BASTU) or the New Pump and Treat Facility (NPTF) being built. Costs for these units are already established.

Version 4 is the same as version 3 except the system would be operated indefinitely.

These costs are approximate for comparison of different options. Total Life Cycle Costs (net present value) are presented in the Field Demonstration Report, Table 2-3 and Figures B-39 and B-40.

3. COST ESTIMATE

Operation COST TOTALS Sheet 3 of 22

Job ISB TREATMENT SYSTEM (PRELIMINARY DESIGN, P-1) Est By AJC Date 5/23/00

Description			
CAPITAL COSTS (SH 4 OF 6)		92,000	
OPERATIONAL COSTS (ANNUAL)			
SUPPLIES			
SODIUM LACTATE	124,500		
PROCESSING	18,000		
INSPECTIONS	600		
SUPPORT SERVICES	700		
TOTAL OP. COSTS	143,800		

Operation ONE YEAR OP. COST — Sheet 4 of 22

Job ISB VERSION 1 + 2 — Est By AJC — Date 5/23/00

Description	Quan	MAT up	MAT Total	LAB up	LAB Total	SUB up	SUB Total
MATERIALS							
SODIUM LACTATE	300 BBL	415	124,500				
PROCESSING COSTS							
OPERATOR	600 Hr			30	18,000		
SYSTEM INSPECTIONS -	20 Hr			30	600		
SUPPORT SERVICES							
RCT .25 Hr/WK	13 Hr			30	390		
CRAFT LABOR	7 Hr			45	310		
TOTAL OP. COSTS			124,500		19,300		

Form No E5a

Operation CONSTRUCTION COSTS Sheet 5 of 22

Job ISB - INJECTION Est By JCG Date 8-26-99

Description			
DIRECT COSTS	55,872		
CONTRACTOR OVERHEAD	8,388		
CONTRACTOR PROFIT	6420		
TOTAL CONST COST	70,680		
CONTENGENCY	21,320		
TOTAL	92,000		

Form No E5

Operation P-1 | Sheet 6 of 22

Job ISB NUTRIENT INJECTION | Est By JCG | Date 8-26-99

Code	Description	Quan	UM	MR	Total Man Hrs	Unit Costs Lab	Unit Costs Mat	Unit Costs Other	LABOR	MATERIAL	SUPPLY	OTHER	TOTAL
11	EQUIPMENT (SEE ATTACHED)	2	EA		240	45			10,800	29000	864	Ø	31,664
15	MECH PIPE (INT)	100	LF	1.5	150	45	10		6750	1000	540	Ø	8290
	(EXT)	500	LF	2.5	1250	45	20		56250	10,000	4500	Ø	70,750
16	ELECT (1/3 GWTF)	ALLOW							12800	15,800	3168	Ø	31,768
	TOTAL									46,800	9072	Ø	55,872

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Operation EQ (P-1) Sheet 7 of 22

Job ISB NUTRIENT INJ. Est By JCG Date 8-26-99

Description	Quan	MAT		LAB		SUB	
		up	Total	up	Total	up	Total
NUTRIENT TANK	1						
(5000 GAL)		10K	10,000	7	20		
METERING PUMP	1	5K	5000		120		
INSTRUMENTS (10)	1 LOT		5,000		100		
			20,000		240		
			$		HR		

Form No E5a

In Situ Bioremediation Planning Conceptual Design, Test Area North, Operable Unit 1-07B (Draft)

1. DESIGN OVERVIEW

The In Situ Bioremediation (ISB) Treatment system is the facility that will inject nutrients into the subsurface within the Operable Unit (OU) 1-07B hot spot as a means of stimulating biological degradation of the subsurface contaminants. This system will be put in place as part of the final remedial action in support of Phase C as described in the *Remedial Design/Remedial Action Scope of Work, Test Area North Final Groundwater Remediation Operable Unit 1-07B*, (U.S. Department of Energy Idaho Operations Office [DOE-ID] 1997). This system will support the long-term cleanup of the OU 1-07B "hot spot" which is the contaminated groundwater within the vicinity of the injection Well Technical Support Facility (TSF)-05.

Implementation of the ISB technology will be an Agency decision based on the results of the ISB Treatability Field Evaluation performed at the Test Area North (TAN).

1.1 Process System Requirements

When evaluating the possible ways of configuring the final implementation strategy for ISB, four different versions or results were considered. The system requirements that will actually be implemented will be dependent on what version is selected.

Each version corresponds to certain results obtained during the field evaluation. The four possible outcomes of the field evaluation and related versions are listed as follows:

- Version 1: ISB achieves **complete** dechlorination **with** source degradation.
- Version 2: ISB achieves **complete** dechlorination **without** source degradation.
- Version 3: ISB achieves **partial** dechlorination **with** source degradation.
- Version 4: ISB achieves **partial** dechlorination **without** source degradation.

For the first two versions, a nutrient injection system is all that is needed to contain and/or remove the hot spot for final remediation. Therefore, the design of the systems that correspond to these two versions will consist of upgrading the existing ISB nutrient injection system to accommodate long term operations. The only difference between versions 1 and 2 will be the length of time that the system will be required to operate.

For versions three and four, the same nutrient injection system will be required along with an additional capture and treatment system that will maintain hydraulic containment for the contaminants of concern (COCs) that continue to leave the vicinity of the hot spot. For each of these versions, two separate systems will be evaluated to provide the hydraulic containment. The first system alternative will consist of a new pump and treat system that will utilize air stripping to capture and treat any COCs that are not destroyed in the hot spot. This unit will be located near TAN-29, and will be similar to the existing air stripper unit used during the ISB field evaluation. The second system alternative will be to use the New Pump and Treat Facility (NPTF) as the hydraulic barrier for any COCs that leave the hot spot for the duration of the remedial action.

System requirements that will be applicable to all equipment designed for these versions is listed as follows:

- The systems will be designed for a 30-year operating life.
- Compliance/performance monitoring is required to show progress in obtaining the Record of Decision (ROD) remedial action objectives. TAN-28 and (2) new transverse performance monitoring wells will be installed for this purpose.
- Freeze protection shall be provided for all exterior piping. All enclosures will be heated to provide freeze protection for any interior piping.
- Fire protection systems will be installed as specified in fire hazards analysis and Life Safety Code. These requirements will include portable fire extinguishers and exit and emergency lighting.

Other system requirements will be identified in the system descriptions in Section 2.

1.2 Assumptions

1.2.1 Common Assumptions/Operational Conditions

The following assumptions are common to each of the possible versions:

- The nutrient injection system will deliver sodium lactate as the primary nutrient. If an alternate electron donor (nutrient) is selected for use, it will be injected at nearly the same volume as the sodium lactate.
- The nutrient injection system will be capable of injecting ammonium phosphate as a nutrient amendment.
- No Resource Conservation and Recovery Act RCRA containment features are necessary for the nutrient injection system.
- No RCRA inspections are required of the nutrient injection system.
- Nutrients may be injected into any combination of Wells TSF-05, TAN-25, TAN-26, and TAN-37.
- The NPTF will be used to clean up the medial zone and must operate for at least 5 years after the hot spot is contained.

2. SYSTEM DESCRIPTION

2.1 General

The actual final equipment configuration will be dependent on the version selected for implementation. With each of the possible versions, the ISB nutrient injection system will be the same. The nutrient injection system will consist of the equipment and piping needed to inject the desired nutrients into Wells TSF-05, TAN-25, TAN-26, and TAN-37. The system will inject sodium lactate (or possibly other nutrients) into a potable water line that is then injected into either TSF-05, TAN-25, TAN-26, or TAN-37. The process flow for this system is shown in Drawing P-1 and is applicable to all the possible versions.

The other two systems that will be included within the various versions are the BASTU and the NPTF. The BASTU will be an air stripper unit similar to the treatment used during the field evaluation that has some minor changes to support the longer duration operating timeframe. The BASTU process flow is presented in Drawing P-2. The NPTF will be used as designed without any modifications.

2.2 Version 1

Version 1 assumes that the ISB technology has been proven to be capable of not only removing the dissolved phase contaminants from within the hot spot, but also being able to effectively attack and remove source material. In this version, the only system component that is needed is related to upgrading the existing nutrient injection system to better accommodate automatic and long term operation.

2.2.1 Process Equipment

Nutrient Injection System—The existing nutrient injections system will be modified to provide the following additional capabilities:

- Automatic distribution of the nutrients
- Provide a holding tank for the nutrients that will allow for long term operation
- Connect the distributions system to allow injection into TSF-05, TAN-25, TAN-26 and TAN-37.

The components within the existing nutrient injection system will remain in place and operate as originally installed.

2.2.2 Process Enclosure

A permanent enclosure will be provided for the nutrient holding tank. The existing nutrient enclosure seavan will remain in place to house the process monitoring equipment.

The new enclosure will be approximately 4.8 × 4.8 m (16 × 16 ft) with an interior height of approximately 6 m (20 ft).

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2.2.3 Operational Materials

The consumable materials required for operation consist of the following estimated quantities:

- Sodium lactate—maximum of 6 drums per week
- Spare parts—metering pump, valves, valve actuators, level transmitters, and miscellaneous instrumentation.

2.2.4 Utilities

Electrical power will be is supplied by the pole mounted 300 KVA 13,800/480 V step-down transformers used to supply the existing nutrient injection system. Power will be supplied to a main control panel that will control all instrumentation, piping heat trace, and pump operation

2.2.5 Manning

The system will operate unmanned 24 hours a day, 7 days a week. The only operational requirements will be to load the nutrient tank on a periodic basis and monitor and set the distribution sequence for the nutrients. The system will be designed for unmanned operation and will have the necessary alarms and notification equipment to notify operation personnel of any upset conditions. The manpower loading is estimated as follows:

- Operations—1 operator (or construction engineer) at 2 days a week
- Routine maintenance—1 operator at 1 day a month.
- Inspections—1 operator (or construction engineer) at 1 day a month.

2.3 Version 2

Version 2 assumes the ISB technology has been proven to be capable of removing the dissolved phase contaminants from within the hot spot. In this version, the only system component that is needed is related to upgrading the existing nutrient injection system to better accommodate automatic and long-term operation. The primary difference between this version and Version 1 is related to the fact that in Version 1, the source will be removed. In this version, the ISB system will be a contaminant barrier; however, it will not remove the source. As a result, this system will need to remain in place and operate indefinitely.

2.3.1 Process Equipment

Nutrient Injection System—The existing nutrient injection system will be modified to provide the following additional capabilities:

- Automatic distribution of the nutrients
- Provide a holding tank for the nutrients that will allow for long-term operation

- Connect the distributions system to allow injection into TSF-05, TAN-25, TAN-26, and TAN-37.

The components within the existing nutrient injection system will remain in place and operate as originally installed.

2.3.2 Process Enclosure

A permanent enclosure will be provided for the nutrient holding tank. The existing nutrient enclosure seavan will remain in place to house the process monitoring equipment.

The new enclosure will be approximately 4.8 × 4.8 m (16 × 16 ft) with an interior height of approximately 6 m (20 ft).

2.3.3 Operational Materials

The consumable materials required for operation consist of the following estimated quantities:

- Sodium Lactate—maximum of 6 drums per week
- Spare parts—metering pump, valves, valve actuators, level transmitters, and miscellaneous instrumentation.

2.3.4 Utilities

Electrical power will be is supplied by the pole mounted 300 KVA 13,800/480 V step-down transformers used to supply the existing nutrient injection system. Power will be supplied to a main control panel that will control all instrumentation, piping heat trace, and pump operation

2.3.5 Manning

The system will operate unmanned 24 hours a day, 7 days a week. The only operational requirements will be to load the nutrient tank on a periodic basis and monitor and set the distribution sequence for the nutrients. The system will be designed for unmanned operation and will have the necessary alarms and notification equipment to notify operation personnel of any upset conditions. The manpower loading is estimated as follows:

- Operations—1 operator (or construction engineer) at 2 days a week
- Routine maintenance—1 operator at 1 day a month
- Inspections—1 operator (or construction engineer) at 1 day a month

2.4 Version 3

Version 3 assumes that the ISB technology has been proven to provide a significant reduction in COCs, but is not quite effective enough to completely contain all the COCs and the respective daughter products that may be produced during the dechlorination process. This version does assume that the ISB technology effectively attacks and removes the source material. Because of its capability to remove the source, the overall duration of the remedial action will be reduced. For this version the existing nutrient injection system will be upgraded as described in the previous versions along with the operation of an additional system that will provide hydraulic containment of the COCs that escape the hot spot area. This version is divided into to sub-versions or different alternatives as to what is used for the hydraulic containment system. The differences between the two alternatives is that version 3a uses a new BASTU for containment, while version 3b uses the NPTF for containment.

2.4.1 Process Equipment

Nutrient Injection System—The existing nutrient injection system will be modified to provide the following additional capabilities:

- Automatic distribution of the nutrients
- Provide a holding tank for the nutrients that will allow for long-term operation
- Connect the distributions system to allow injection into TSF-05, TAN-25, TAN-26, and TAN-37.

The components within the existing nutrient injection system will remain in place and operate as originally installed.

Bioremediation Air Stripper Treatment Unit (Version 3a)—Groundwater will be extracted from TAN-29, treated and discharged into TAN-49 at a pumping rate of 50 gpm. A standard model, low-profile air stripper will be used to provide removal of volatile organic compounds (VOCs) at an efficiency of at least 99.6% when processing the water at 189 L/min (50 gpm). The air stripper unit will be equipped with a forced air blower that will input approximately 600 cfm of air in a counter flow configuration relative to the water stream. Outside air will be supplied to the blowers through inlet ductwork, which will eliminate the need to heat the incoming blower supply air. Calculations show that a minimum flowrate of 26.5 L/min (7 gpm) is needed to prevent freeze-up of the air stripper at 900 cfm of -40°C (-40°F) outside supply air.

As an alternative to using the BASTU for containment, Version 3b proposes using the existing NPTF to perform this function. No additional equipment or systems will need to be constructed for Version 3b.

2.4.2 Process Enclosure

Version 3a—Two permanent enclosures will be constructed for this version, a nutrient holding tank enclosure and the BASTU enclosure. The existing nutrient enclosure seavan will remain in place to house the process monitoring equipment.

The nutrient holding tank enclosure will be approximately 4.8 × 4.8 m (16 × 16 ft) with an interior height of approximately 6 m (20 ft). The BASTU enclosure will house all the process equipment for the air stripper and will be approximately 6 × 6 m (20 × 20 ft) with an interior height of approximately 3.6 m (12 ft).

Version 3b—The only enclosure needed for this version is the nutrient holding tank enclosure. The existing nutrient enclosure seavan will remain in place to house the process monitoring equipment.

Preliminary

The new enclosure will be approximately 4.8 × 4.8 m (16 × 16 ft) with an interior height of approximately 6 m (20 ft).

2.4.3 Operational Materials

The following consumable materials are required for both Versions 3a and 3b:

- Sodium Lactate—maximum of 6 drums per week
- Spare parts—metering pump, valves, valve actuators, level transmitters, and miscellaneous instrumentation.

For Version 3a, there will be additional spare parts needed that will consist of a spare blower, discharge pump, and associated instrumentation and control valves.

2.4.4 Utilities

Electrical power will be supplied by pole mounted 300 KVA 13,800/480 V step-down transformers used to supply the existing nutrient injection system and the original ISB Air Stripper Treatment Unit. Power will be supplied to a motor control center that will contain all motor starters, supply breakers for the enclosure heaters, supply breaker for the 480/120 V transformer, and the piping heat trace.

2.4.5 Manning

The system will operate unmanned 24 hours a day, 7 days a week. The only operational requirements will be to load the nutrient tank on a periodic basis and monitor and set the distribution sequence for the nutrients. The system will be designed for unmanned operation and will have the necessary alarms and notification equipment to notify operation personnel of any upset conditions. The manpower loading is estimated as follows:

- Operations—1 operator (or construction engineer) at 2 days a week
- Routine maintenance—1 operator at 1 day a month
- Inspections—1 operator at 1 hour a day, 7 days a week.

2.5 Version 4

Version 4 assumes that the ISB technology has been proven to provide a significant reduction in COCs, but is not quite effective enough to completely contain all the COCs and the respective daughter products that may be produced during the dechlorination process. In addition, this version assumes that the ISB technology does not effectively remove the source material. For this version, the existing nutrient injection system will be upgraded as described in the previous versions, along with the operation of an additional system that will provide hydraulic containment of the COCs that escape the hot spot area. This version is divided into to sub-versions or different alternatives similar to those in Version 3. The two alternatives are related to what system is to be used to provide hydraulic containment of the COCs. The differences between the two alternatives is that Version 4a uses a new BASTU for containment, while Version 4b uses the NPTF for containment. In either case, both the nutrient injection system and the containment system must be operated indefinitely (greater than 30 years).

2.5.1 Process Equipment

Nutrient Injection System—The existing nutrient injection system will be modified to provide the following additional capabilities:

- Automatic distribution of the nutrients
- Provide a holding tank for the nutrients that will allow for long term operation
- Connect the distributions system to allow injection into TSF-05, TAN-25, TAN-26, and TAN-37.

The components within the existing nutrient injection system will remain in place and operate as originally installed.

Bioremediation Air Stripper Treatment Unit (Version 4a)—Groundwater will be extracted from TAN-29, treated and discharged into TAN-49 at a pumping rate of 50 gpm. A standard model, low-profile air stripper will be used to provide removal of VOCs at an efficiency of at least 99.6% when processing the water at 189 L/min (50 gpm). The air stripper unit will be equipped with a forced air blower that will input approximately 600 cfm of air in a counter flow configuration relative to the water stream. Outside air will be supplied to the blowers through inlet ductwork, which will eliminate the need to heat the incoming blower supply air. Calculations show that a minimum flowrate of 7 gpm is needed to prevent freeze-up of the air stripper at 900 cfm of -40°C (-40°F) outside supply air.

As an alternative to using the BASTU for containment, Version 4b proposes using the existing NPTF to perform this function. No additional equipment or systems will need to be constructed for Version 4b.

2.5.2 Process Enclosure

Version 3a—Two permanent enclosures will be constructed for this version, a nutrient holding tank enclosure and the BASTU enclosure. The existing nutrient enclosure seavan will remain in place to house the process monitoring equipment.

The nutrient holding tank enclosure will be approximately 4.8 × 4.8 m (16 × 16 ft) with an interior height of approximately 6 m (20 ft). The BASTU enclosure will house all the process equipment for the air stripper and will be approximately 6 × 6 m (20 × 20 ft) with an interior height of approximately 3.6 m (12 ft).

Version 3b—The only enclosure needed for this version is the nutrient holding tank enclosure. The existing nutrient enclosure seavan will remain in place to house the process monitoring equipment.

The new enclosure will be approximately 4.8 × 4.8 m (16 × 16 ft) with an interior height of approximately 3.6 m (20 ft).

2.5.3 Operational Materials

The following consumable materials are required for both Versions 3a and 3b.

- Sodium Lactate – maximum of 6 drums per week

- Spare parts- Metering pump, valves, valve actuators, level transmitters, and miscellaneous instrumentation.

For Version 4a, there will be additional spare parts needed that will consist of a spare blower, discharge pump, and associated instrumentation and control valves.

2.5.4 Utilities

Electrical power will be is supplied by the pole mounted 300 KVA 13,800/480 V step-down transformers used to supply the existing nutrient injection system and the original ISB Air Stripper Treatment Unit. Power will be supplied to a motor control center that will contain all motor starters, supply breakers for the enclosure heaters, supply breaker for the 480/120 V transformer, and the piping heat trace.

2.5.5 Manning

The system will operate unmanned 24 hours/day, 7 days/week. The only operational requirements will be to load the nutrient tank on a periodic basis and monitor and set the distribution sequence for the nutrients. The system will be designed for unmanned operation and will have the necessary alarms and notification equipment to notify operation personnel of any upset conditions. The manpower loading is estimated as follows:

- Operations—1 operator (or construction engineer) at 2 days a week

- Routine maintenance—1 operator at 1 day a month

- Inspections—1 operator at 1 hour a day, 7 days a week.

3. EQUIPMENT LIST

Table 3-1 provides a list of the major components that will be added for the final remedial system.

Table 3-1. Equipment list and description.

Service	Quantity	Description
Nutrient Injection System		
Nutrient Holding Tank	1	Vertical tank, 5,000 gallon flat bottom enclosed top, 12 ft diameter × 10 ft-3 in.", polyethylene construction, 10 nozzles,
Metering Pump	1	Metering pump, capable for a 10:1 reduction in flowrate
Instrumentation		TBD
Bioremediation Air Stripper Treatment Unit		
Air Stripper	1	Low profile air stripper, four tray, Polyethylene construction, 20 – 100 gpm flow rate, Stripper skid mounted, 99.6% removal efficiency for TCE @ 50 gpm, 55°F water.
Air Blowers	2	6 hp forced draft blowers, 600 scfm @ ________ static pressure.
Stripper sump pumps	2	Centrifugal single stage pump, 2 in. suction, 1 ½ in. discharge, 100 gpm @ 80 ft head, 5 hp, 480V, 3 phase
Stripper sump level control valve	1	3 in. level control valve, rotary plug style, CS or SST 150# body, electric actuator, modulating service, 55°F water, linear operating characteristic, max ΔP across valve =50 psi, valve sizing ΔP=? psi at 125 gpm, C_V = ? min, input control signal 4-20 mAdc, Available power for electric actuator will be 120 VAC, 60 Hz, single phase.
		Manufacturer-Leslie Controls, Tampa, FL, K-Max model, Jordan electric actuator.

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4. AIR EMISSIONS

The air emissions from the air stripper will be limited based on the discharge limits set in the OU 1-07B ROD and additional modeling performed for the NPTF. The ROD limits were set based on modeling of the Groundwater Treatment Facility (GWTF) location and operations.

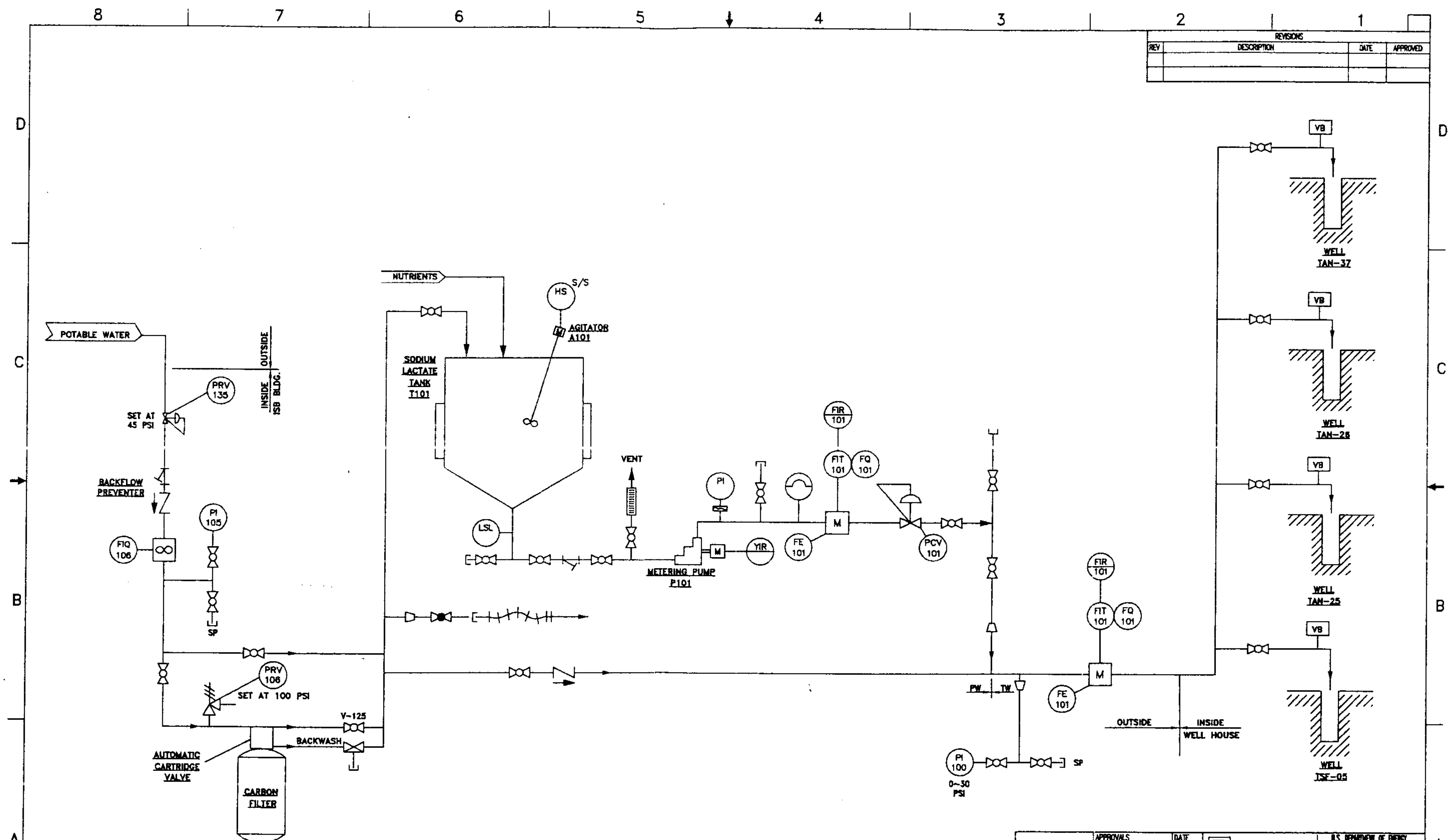
The results of the air modeling for the NPTF and the GWTF (as specified in the ROD) are shown in Table 4-1. Until further design is completed and a separate air modeling limit is set specifically for the BASTU the most conservative limits listed in Table 4-1 will be used as the compliance limits.

Table 4-1. Air discharge limits.

	NPTF Modeling (SCREEN3) lbs/hr	ROD Limits (SCREEN) lbs/hr
TCE	0.18	0.185
PCE	4.9	5.05
DCE	564.3	1,254
VC	0.33	N/A

5. REFERENCES

DOE-ID 1997, *Remedial Design/Remedial Action Scope of Work, Test Area North, Final Groundwater, Operable Unit 1-07B*, U.S. Department of Energy Idaho Operations Office, DOE/ID-10522, Revision 5, August.



PARSONS

FOR U.S. DEPARTMENT OF ENERGY IDAHO OPERATIONS OFFICE IDAHO FALLS, IDAHO

OU 1-07B ISB NUTRIENT INJECTION
PROCESS FLOW DIAGRAM
FINAL REMEDIATION

PROJECT NO.S	
DESIGN PHASE	10% DESIGN
APPROVALS	DATE
CONST REV	
P.M.	
DES MGR	
DESIGN	
CHECKED	
DRAWN	
SUBCONTRACT NO.	
RELEASED	
APPROVED	DATE

SIZE D SCALE NONE

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ADOCS NO.

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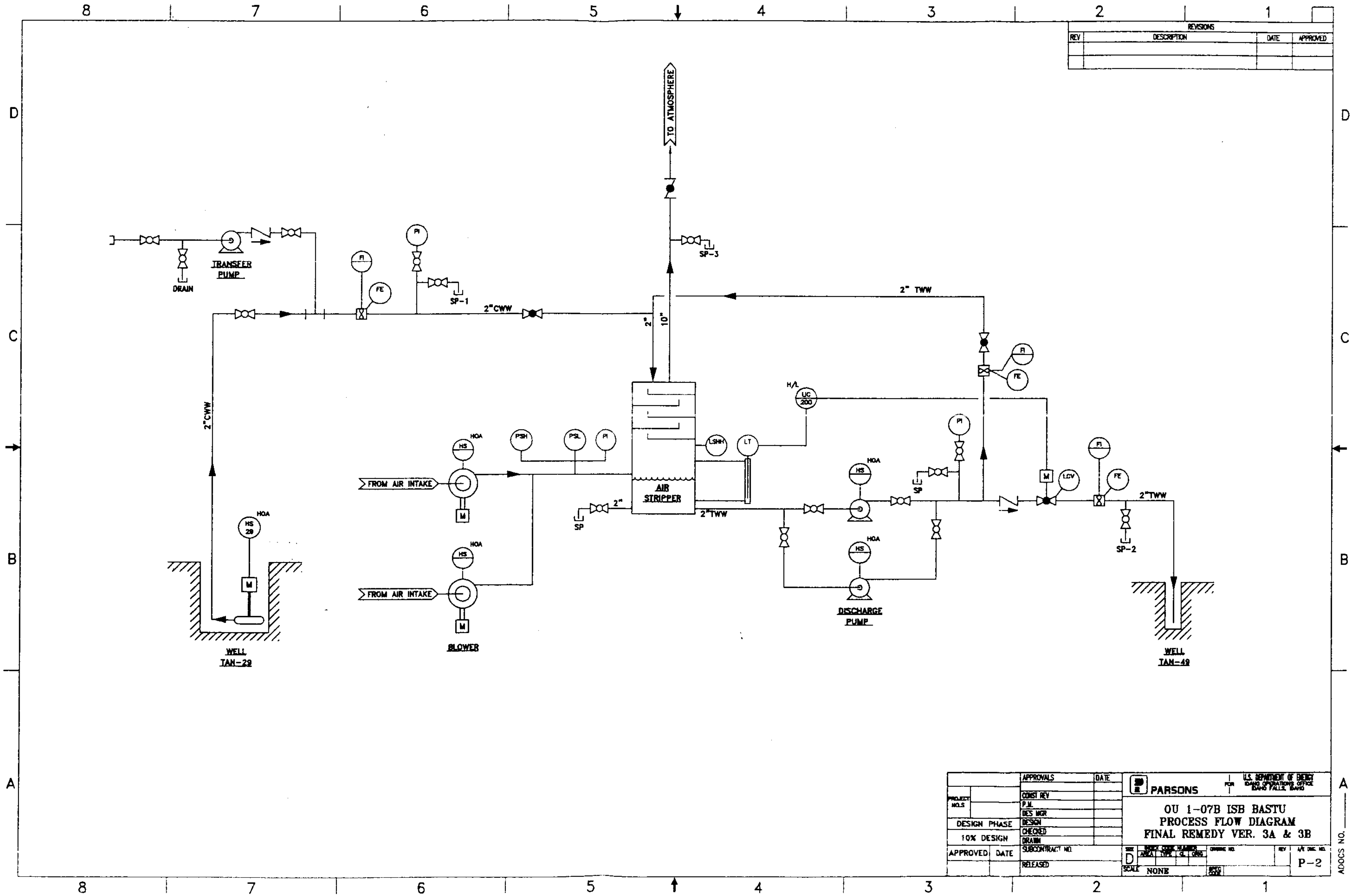

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